

Appl. No. : 09/855,321
Filed : May 14, 2001

AMENDMENTS TO THE CLAIMS

1. - 16. (Cancelled).

17. (Currently Amended) A method of depositing a thin film on a substrate, in which method a substrate placed in a reaction space including a reaction chamber is subjected to alternately repeated surface reactions of at least two vapor-phase reactants for the purpose of forming a thin film, the reaction space defining a reaction space volume, the method comprising feeding the reactants in the form of vapor-phase pulses repeatedly and alternately, each reactant fed from a separate source, into the reaction space, and bringing the vapor-phase reactants to react with a surface of the substrate for the purpose of forming a solid-state thin film compound on the substrate, wherein

two reaction space volumes of gas are moved through the reaction space ~~a volume of gas corresponding to the volume of the reaction space is evacuated essentially totally in~~ an interval between each two successive vapor-phase reactant pulses.

18. (Currently Amended) The method of Claim 17, wherein ~~a volume of gas corresponding to~~ at least three ~~[[two]]~~ gas reaction space volumes of gas are moved through the reaction space ~~is evacuated~~ in the interval between each two successive vapor-phase reactant pulses.

19. (Currently Amended) The method of Claim 17, wherein ~~a volume of gas corresponding to~~ 3 - 10 gas reaction space volumes of gas are moved through the reaction space is evacuated in the interval between each two successive vapor-phase reactant pulses.

20. (Currently Amended) The method of Claim 17, wherein a volume of gas ~~corresponding to the two~~ gas reaction space volumes of gas are moved through ~~volume of the reaction space is evacuated~~ so that residual components of an immediately preceding vapor-phase reactant pulse remaining in the reaction chamber are reduced to a level of less than 1 % during the interval prior to the inflow of a subsequent vapor-phase pulse.

21. (Currently Amended) The method of Claim 17, wherein ~~a volume of gas corresponding to the two~~ reaction space volumes of gas are moved through ~~gas volume of the reaction space is evacuated~~ so that residual components of an immediately preceding vapor-phase reactant pulse remaining in the reaction chamber are reduced to a level of less than 0.1 % during the interval prior to the inflow of a subsequent vapor-phase pulse.

Appl. No. : 09/855,321
Filed : May 14, 2001

22. (Currently Amended) The method of Claim 17, wherein an inactive gas is fed into the reaction space simultaneously as the two reaction space volumes of gas are being moved through the reaction space~~reaction space is being evacuated from residues of the latest vapor-phase reactant pulse.~~

23. (Currently Amended) The method of Claim 22, wherein the reaction space is connected to a pump having a volumetric capacity which during the interval between each two successive vapor-phase reactant pulses is appreciably greater than the reaction space gas-volume of the reaction space.

24. (Currently Amended) The method Claim 17, wherein each reactant is fed into the reaction chamber via a separate inflow path in order to minimize the reaction space gas volume to be evacuated from the reaction space.

25. (Previously Presented) The method of Claim 17, wherein each vapor-phase reactant pulse is mixed with the inactive gas flow prior to its entry into the reaction space.

26. (Currently Amended) The method of Claim 17, wherein the reaction space is defined by the reaction chamber configured to house the substrate, further comprising providing gas flow channels in communication with the reaction chamber, the gas flow channels being suited for the inflow of the vapor-phase reactant pulses into the reaction chamber and, correspondingly, for the outflow of excess components of the reactant pulses from the reaction chamber, characterized in that at least a portion of the gas flow channels are provided with a narrow, oblong cross section in order to minimize the reaction space volume of the reaction space.

27. (Currently Amended) The method of Claim 17, wherein the reaction space is defined by the reaction chamber configured to house the substrate, further comprising providing gas flow channels in communication with the reaction chamber, the gas flow channels being suited for the inflow of the vapor-phase reactant pulses into the reaction chamber and, correspondingly, for the outflow of excess components of the reactant pulses and gaseous reactant byproducts from the reaction chamber, wherein the reaction chamber is provided with a narrow, oblong cross section in order to minimize the reaction space volume of the reaction space.

28. (Previously Presented) The method of Claim 27, characterized in that the vapor-phase reactant pulses are fed via gas flow channels having a narrow, oblong cross section in order

Appl. No. : 09/855,321
Filed : May 14, 2001

to form at least essentially planar pulses of vapor-phase reactant and to improve intermixing of the vapor-phase reactant flow with a carrier gas flow.

29. (Previously Presented) The method of Claim 27, characterized in that the vapor-phase pulses of each reactant group are fed via their individual inflow channels directly into the reaction chamber, wherein the vapor-phase pulse is allowed to intermix with a carrier gas flow prior to bringing the reactant into contact with the substrate.

30. (Previously Presented) The method of Claim 27, wherein the gas flow channels each include an infeed opening to the reaction chamber having a width-to-height ratio between about 5:1 and 50:1.

31. (Previously Presented) The method of Claim 30, wherein the infeed opening width-to-height ratio is between about 5:1 and 30:1.

32. (Previously Presented) The method of Claim 17, wherein the vapor-phase reactant pulses are fed in a laminar flow into the reaction chamber.

33. (Previously Presented) The method of Claim 17, wherein the interval is on the order of 1 second.

34. (Currently Amended) The method of Claim 33, wherein at least three ~~[[two]]~~ reaction space volumes of gas volumes of the reaction space are moved through the reaction space ~~[[is]]~~ evacuated in the interval between each two successive vapor-phase reactant pulses.

35. (Currently Amended) The method of Claim 33, wherein ~~a gas volume~~ corresponding to 3-10 reaction space volumes of gas are moved through the reaction space ~~volumes of the reaction space is evacuated~~ in the interval between each two successive vapor-phase reactant pulses.

36. (Previously Presented) The method of Claim 17, wherein feeding the reactants comprises defining a gas flow front entering the reaction chamber with a width between about 10 cm and 30 cm.

37. (Previously Presented) The method of Claim 36, wherein the gas flow front has a height between about 1 cm and 3 cm.

38. (Previously Presented) The method of Claim 17, wherein the reaction space defines a width-to-height ratio between about 1:1 and 100:1

39. (Previously Presented) The method of Claim 38, wherein the width-to-height ratio is between about 5:1 and 50:1

Appl. No. : 09/855,321
Filed : May 14, 2001

40. (Previously Presented) The method of Claim 38, wherein the width-to-height ratio is between about 5:1 and 30:1.

41. (Currently Amended) A method of depositing thin films by atomic layer deposition, wherein at least first and second vapor-phase reactants are alternately fed to a reaction space including a reaction chamber from separate inflow channels, the reaction space defining a reaction space volume, the method comprising a plurality of cycles in which each cycle includes:

in a first pulse, flowing the first vapor-phase reactant through a first inflow channel opening directly into the reaction chamber, the reaction chamber housing a substrate upon which a thin film is to be deposited;

in the first pulse, flowing only an inactive gas through a second inflow channel while flowing the first vapor-phase reactant through the first inflow channel, the second inflow channel opening directly into the reaction chamber;

in a second pulse, flowing the second vapor-phase reactant through the second inflow channel;

in the second pulse, flowing only an inactive gas through the first inflow channel while the second vapor-phase reactant flows through the second inflow channel; and

moving two reaction space volumes of gas through the~~evacuating essentially totally a volume of gas corresponding to the gas volume of a~~ reaction space in an interval between each two successive pulses of the first and second vapor-phase reactants, the reaction space defined by the reaction chamber, the first inflow channel and the second inflow channel.

42. (Previously Presented) The method of Claim 41, further comprising allowing the first vapor-phase reactant from the first inflow channel to mix with the inactive gas from the second inflow channel within the reaction chamber upstream of the substrate during the first pulse, and allowing the second vapor-phase reactant from the second inflow channel to mix with the inactive gas from the first inflow channel within the reaction chamber upstream of the substrate during the second pulse.

43. (Currently Amended) The method of Claim 41, wherein ~~a gas volume corresponding to~~ at least three ~~[[two]]~~ reaction space volumes of gas ~~volumes of the reaction space is evacuated~~ are moved through the reaction space in the interval between each two successive pulses of the first and second vapor-phase reactants.